The Pocket Planetarium ★

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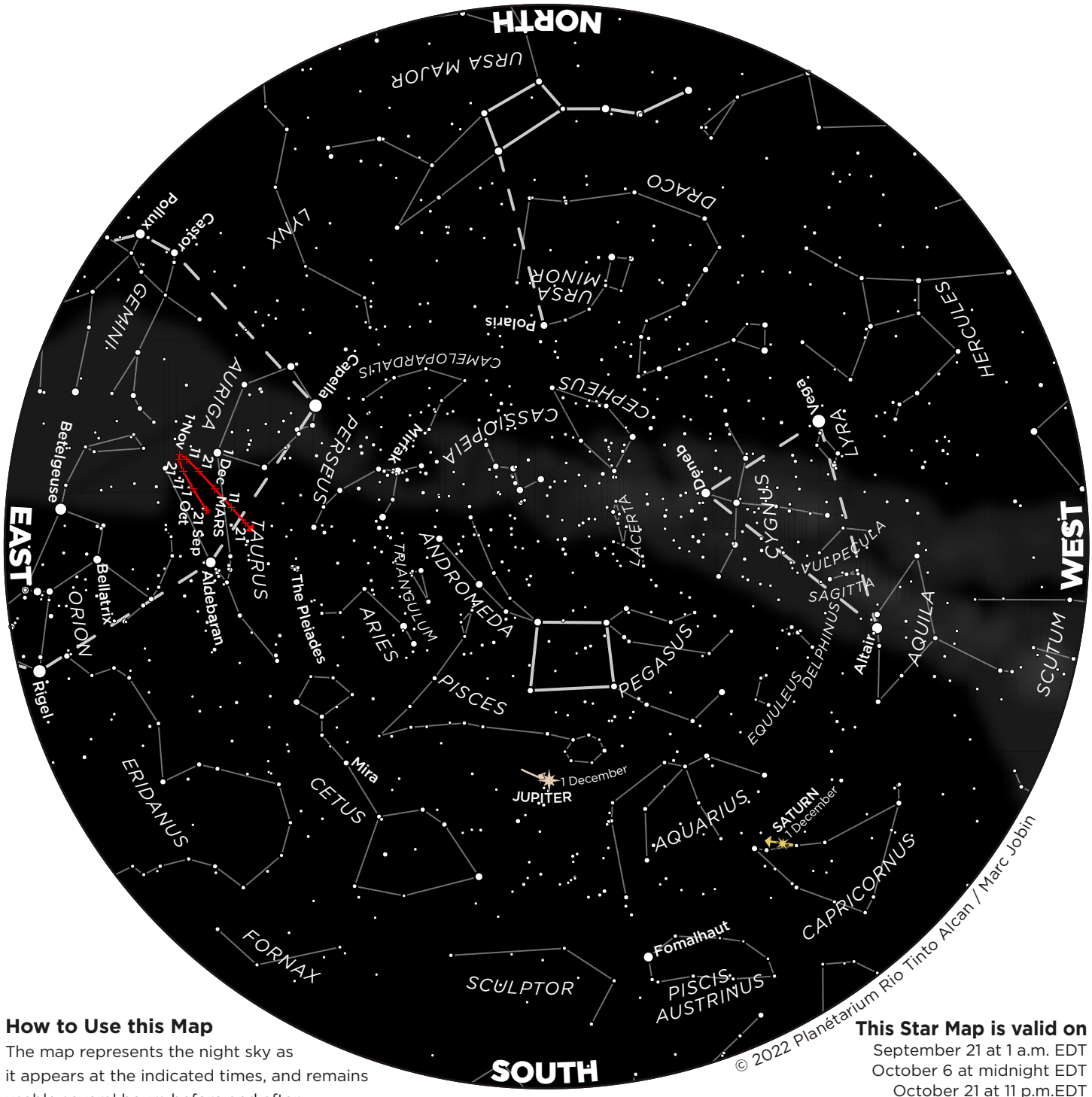
Astronomical Information Newsletter of the Rio Tinto Alcan Planetarium

The Starry Sky — Autumn 2022



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 shaded area outlines the Milky Way.

This Star Map is valid on

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 Sky This Autumn

The bright planets make quite an impression in the fall sky... except for Venus, which will keep a low profile over the next few weeks while preparing for a strong comeback in the evening sky this winter.

Jupiter dominates the night sky

Jupiter reaches opposition on September 26, meaning it is diametrically opposite the Sun on the celestial dome. From dusk to night's end, the brilliant planet completely dominates the night sky this fall: The surrounding stars, in the inconspicuous constellations Pisces and Cetus, seem quite pale in comparison. They will nevertheless serve as a marker to track the daily movement of Jupiter, which undergoes its retrograde loop from July 28 to November 23.

In early fall, the giant planet culminates in the middle of the night, about 45 degrees above the southern horizon—about 13 degrees higher than in 2021 and a significant improvement over recent years. This will also create better viewing conditions of the giant planet through a telescope and may reveal the finer details in the cloud bands that streak across the Jovian disc, about 45 arc seconds wide by mid-season. As the weeks go by, this prime viewing position occurs increasingly earlier in the evening, such that Jupiter culminates at twilight when fall gives way to winter.

On the evening of October 8, the nearly full, waxing gibbous Moon shines just over 3 degrees below Jupiter, low in the east at twilight; the two celestial bodies culminate around midnight, but the gap widens as the evening advances. **On November 4 at twilight,** the waxing gibbous Moon shines less than 3 degrees below Jupiter in the east-southeast, but the gap grows to 2½ degrees throughout the night. **On the evening of December 1,** the waxing gibbous Moon moves to within just 4½ degrees to the lower left of Jupiter as they slowly sink toward the west-southwestern horizon.

Saturn, the "star" of our evenings

Saturn was at opposition on August 14, and is well positioned for telescope viewing this fall. Saturn can be spotted at nightfall and culminates about 30 degrees high in the south during the evening, making it accessible to most of us. The culmination takes place around 10 p.m. in early fall, then increasingly earlier as the weeks go by: By December, Saturn is already at its highest altitude at twilight and vanishes in the west-southwest around 9 p.m.

However, due to its position in the constellation Capricornus, near the border with Aquarius, the ringed planet unfortunately stays low on the horizon: This interferes with telescope viewing because the light that reaches us must take a much longer path through the atmosphere, making it more susceptible to the degrading effects of atmospheric turbulence. The details of its magnificent rings—tilted about 13 degrees this fall—may be difficult to make out, but that doesn't make them any less spectacular!

To the naked eye, Saturn travels very slowly from one evening to another in relation to the faint background stars of Capricornus, moving westward (to the right) until October 22, when it ends its retrograde motion that began June 4. In 2023, the planet will be in Aquarius, slightly higher in the sky: The situation gradually improves for Saturn over the next few years.

On October 5 at twilight, the waxing gibbous Moon hangs 5½ degrees to the lower left of Saturn, but the gap between the two widens over the course of the evening. **On the evening of November 1,** the waxing gibbous Moon lies 4½ degrees below Saturn. On the evening of November 28, it gradually comes to within 5½ degrees below Saturn, as both celestial bodies sink toward the southwestern horizon.

All eyes on Mars

The Martian opposition occurs on December 8—a situation that arises about every 26 months. This fall, **Mars** will make its closest approach to Earth in two years. To the naked eye, the Red Planet becomes a brilliant orange-coloured object that outshines all the stars of Taurus. It begins its retrograde loop on October 30, when it sits between the horns of the celestial Bull. Over the next few weeks, it will appear to travel several degrees backward (westward) towards the Pleiades. **(See map.)** But Mars won't make it all the way to the star cluster, stopping about 7 degrees away on January 12 before resuming its direct eastward motion. The Red Planet is not really moving backwards in its orbit, of course: This retrograde motion is only an illusion created when Earth catches up to and passes Mars in Earth's smaller, faster orbit around the Sun. After opposition, the distance between Mars and Earth again increases: Through a telescope, the planet shrinks very rapidly and grows dimmer in the sky.

On the night of November 10 to 11, the waning gibbous Moon gradually moves to within 2½ degrees to the right of Mars; the pair can be found in the west by night's end and dawn. The gap between the two celestial bodies is 6½ degrees just as they rise in the evening, in the east-northeast. The duo culminates around 2 a.m. **On the evening of December 7,** the full Moon again approaches the Red Planet, but this time covering it completely for several long minutes: a rare planetary occultation that's a must-see! **(See other text.)**

Mercury appears at dawn

As the closest planet to the Sun, **Mercury** is only visible either at dawn or at twilight and only for a few days each time. In the fall, the planet's orbital inclination with respect to the horizon favours its morning forays, as will be the case from September 30 to October 27 when Mercury makes an excellent appearance, reaching its greatest elongation on October 8, 18 degrees west of the Sun. In the days leading up to this viewing window, the planet is too faint to be easily visible; after that it will simply be too low in the sky. The prime viewing period extends from October 4 to 24: That's when Mercury can be spotted above the eastern horizon, 45 minutes before sunrise. **On the morning of October 24,** look for the extremely thin waning Moon, barely 1½ degrees above Mercury; you may want binoculars to help you locate this razor-thin crescent that will be difficult to see in the light of dawn.

Mercury also makes a solid showing in the evening sky from December 11 to 31, reaching its greatest elongation on the 21st, 20 degrees east of the Sun; the planet is too low before the 11th, then very rapidly becomes too dim after the 31st. During the prime viewing window from December 15 to 28, the planet will be visible above the southwestern horizon 30 to 45 minutes after sunset.

Venus passes behind the Sun

Venus has been visible at dawn since January. But after working its way toward the Sun during the last weeks of summer, the beautiful Morning Star is now considerably closer to the horizon. In the early days of fall, the brilliant planet gets lost in the glare of the rising Sun.

On October 22, Venus is in inferior conjunction (on the opposite side of the Sun from Earth), at which point it technically re-enters the evening sky. But due to the unfavourable evening geometry during the fall, we'll have to wait until mid-December to catch a glimpse of it in the twilight glow, very low on the southwestern horizon 30 minutes after sunset. Fortunately, the situation will quickly improve during the first few weeks of 2023, and Venus will ultimately make a very good showing in the evening sky until July.

Clear skies!

Research and text: **Marc Jobin**

The Martian Opposition of 2022

Mars spends most of its time very far from the Earth, so the planet generally appears small in our telescopes, making it hard to observe the finer details. It is only during the few weeks around opposition, which happens about every 26 months, that the Red Planet comes close enough to Earth to offer us a good view. Due to the pronounced ellipticity of the Martian orbit, these favourable periods are not all equivalent in terms of viewing. Depending on the year, the minimum distance between us and Mars can almost double, and the same applies to the Red Planet's apparent size. What also changes from one opposition to another is the constellation in which Mars can be found at that moment: Much like the Sun in summer or winter, the Red Planet can climb very high in the sky or, on the contrary, stay very low on the southern horizon, which affects the viewing experience and the level of visible details.

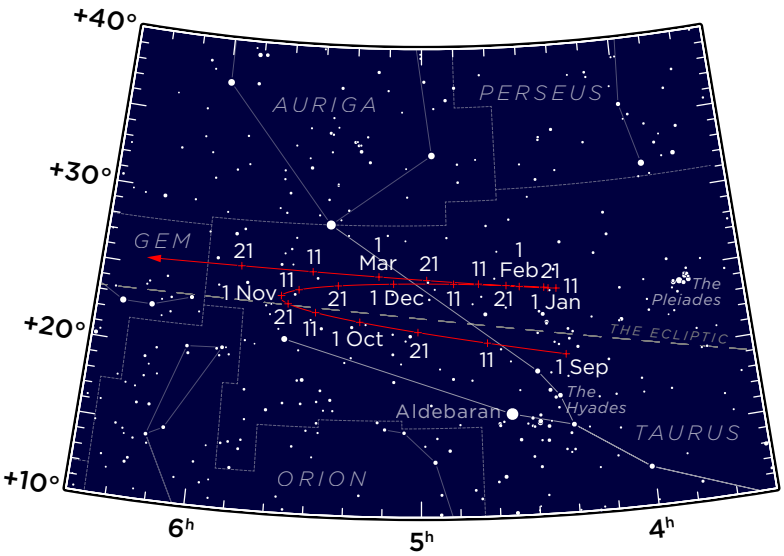
At its next opposition, on December 8, Mars will shine in the constellation Taurus, at a declination greater than +25 degrees. In the grand scheme of things, we can hardly hope for better: At our Quebec latitudes, the Red Planet will culminate at about 69 degrees above the southern horizon, favouring greater image stability when the fall weather permits. On the other hand, Mars will not be at its minimum distance for an opposition, nor at its greatest: At about 81 million km from Earth, it will be 31% farther from us than in 2020 and will appear 24% smaller to us through an eyepiece (apparent diameter of 17 arc seconds versus 22 arc seconds two years ago).

The conditions for observing Mars through a telescope will be best shortly after mid-October: The planet's apparent diameter will be greater than 15 arc seconds and will remain so until December 29. The martian opposition **officially occurs during the night of December 7 to 8, 2022,** when the planet is at a distance of 0.548 AU, with an apparent diameter of 17.1 arc seconds. The Red Planet will shine at magnitude –1.9, outshining every star in the sky. However, due to the different orbital shapes of the Earth and Mars, the Red Planet actually gets **closest to Earth** one week earlier, on November 30, when it is 0.544 AU away from us, has an angular diameter of 17.2 arc seconds, and shines at magnitude –1.8.

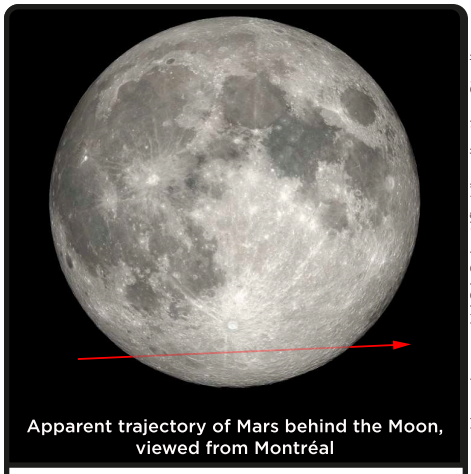
During the main viewing period of Mars, Earth will be directly above (or slightly south of) the Red Planet's equator. A telescope will reveal the two polar regions, just at the edge of the planet's disc. However, since it will be the spring equinox in the Martian northern hemisphere on December 26, it is the north polar cap that will appear largest at the end of winter.

At 24 hours and 37 minutes, the rotation period of Mars is slightly longer than that of Earth. If we look up at the same time every evening, we'll see that Mars lags a little, and the different areographic zones will appear to have moved "backward." But thanks to the planet's rotation over several hours, each viewing period provides an opportunity to observe a large portion of the Martian surface. And in just a few nights of observation spread over a few weeks, the entire planet will have passed before our eyes.

The ***Mars Profiler*** interactive tool, available for free on the *Sky & Telescope* magazine website, shows you which Mars features are visible on any given day and time of the year. Be sure to enter the date and time *in universal time.*



The map at left shows the trajectory of Mars through Taurus, from September 1, 2022, to April 1, 2023. The planet's position is indicated on the 1st, 11th and 21st of each month, at 7 p.m. EST, or 8 p.m. EDT. (Map: Marc Jobin, Planétarium Rio Tinto Alcan)



Apparent trajectory of Mars behind the Moon, viewed from Montréal

Moon image: NASA Scientific Visualization Studio

The Moon occults the Red Planet!

In the late evening of **December 7,** we'll be treated to a rare occultation of Mars by the full Moon. Not only is it an exceptional event—for one thing, planetary occultations are infrequent—but it also, by pure coincidence, occurs the same evening of the Martian opposition!

This occultation will be visible from most of North America (except for the US eastern seaboard, the southeastern US, and Alaska). As is the case for a solar eclipse, the phenomenon occurs at different times depending on the location of the observer. **In Montreal,** the Red Planet's disc (diameter of 17 arc seconds, magnitude –1.9) starts to slip behind the limb of the Moon at 10:41:22 p.m. EST and will take more than a minute to disappear completely at 10:42:40 p.m. About three-quarters of an hour later, Mars gradually reappears between 11:29:02 p.m. and 11:30:22 p.m. The phenomenon takes place very high in the southeast, at more than 66 degrees above the horizon.

As always when it comes to occultations, the exact times of the phenomenon depend on the viewer's precise location and vary by several seconds from one kilometre to another. Make sure your telescope is set-up and pointed toward Mars and the Moon a few minutes before the indicated time so you don't miss anything. Use an instrument with a high enough magnification to distinguish the shape and size of the Martian disc: At least 150X, and even more if your telescope's guiding system allows for excellent tracking of the planet while it is hidden by the Moon.

There's something magical about watching the Red Planet's tiny disc gradually disappear behind the mountain peaks along the Moon's limb, and then reappear. Let me repeat: This is a truly exceptional phenomenon, which you may never have the opportunity to experience again. So, grab your telescopes and get ready to witness a very special event!

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

More to Watch This Autumn

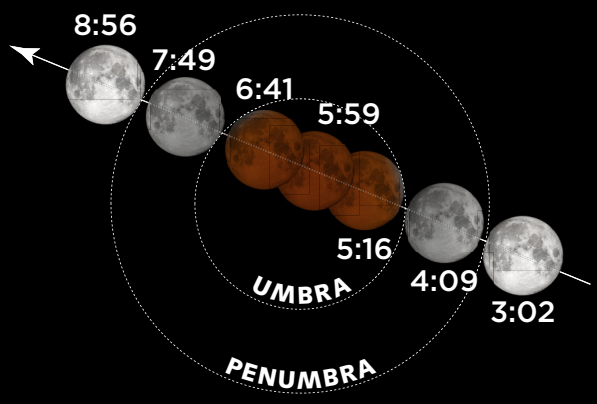
ANOTHER TOTAL ECLIPSE OF THE MOON

For the second time in less than six months, we'll be treated to a total lunar eclipse **in the early morning hours of November 8.** However, it will only be partially visible in Quebec, since the Moon will be setting while the eclipse is still in progress in eastern North America, the Caribbean and South America. To see the entire phenomenon, you'll have to be in the western part of North America, the central regions of the Pacific, New Zealand, the Arctic and the Far East, including Japan.

This eclipse presents a viewing challenge for observers in Quebec. The first half of the phenomenon takes place when the Moon is already very low on the western horizon, which must be perfectly clear and unobstructed to spot the eclipsed Moon. We'll also have to contend with the ever-brightening dawn which will interfere with the Moon's visibility during totality.

The partial phases of the eclipse start at 4:09 a.m. (ET), and the eclipse is total at 5:16 a.m. When the eclipse reaches its maximum, at 5:59 a.m., the Moon will be only 7 degrees high in the west-northwest in Montreal (azimuth = 286°), in the constellation Aries, less than 2 degrees west of Uranus; still in Montreal, the Moon sets toward the end of totality (6:41 a.m.) just as the Sun rises in the opposite direction. But the eclipsed Moon will disappear from view long before it sets, due to an overly bright sky: Until when will you be able to see it?

The next total lunar eclipse **entirely visible from Quebec** will occur on the night of May 13-14, 2025..



The Moon will re-enter the Earth's umbral shadow in the early hours of November 8. North is at the top; at the time the phenomenon occurs for observers in Quebec, the entire figure needs to be rotated about 40 degrees to the right to match the Moon's orientation as it sinks toward the horizon.(Diagram: Marc Jobin/PRTA, based on data by F. Espenak/NASA GSFC; Moon images: NASA SVS)

METEOR SHOWERS

Three "classic" meteor showers are set to grace our fall skies. **The Orionids** will reach their peak around October 21, and although considered one of the least showy of the annual meteor showers, they are long-lasting and have a very broad maximum. This meteor shower is the result of dust left behind by Halley's Comet in its path. The radiant rises around 10 p.m., reaches a reasonable height after midnight and culminates at dawn. The Moon will be new on October 25: The last crescent Moon will slightly impact viewing conditions in the latter part of the night near peak activity, but it won't prevent you from spotting a few shooting stars during your stargazing adventures.

Potential outburst of the Leonids

This year, the bright Moon will dampen the show for the other meteor showers. **The Leonids** are expected to peak in the early evening of November 17, at around 6 p.m. While famous for having produced spectacular "storms" in the past, this meteor shower is usually very weak. In 2022, the models forecast that Earth will cross a stream of dust left behind by comet 55P/Tempel-Tuttle's 1733 passage near the Sun: The encounter is expected around 1:00 a.m. on November 19 (or between 1:20 and 1:27 a.m. according to another model) and could produce a notable, albeit brief, spike in activity. The Leonid radiant rises above the horizon only after midnight and culminates at dawn. However, we will have to contend with the waning Moon, which is already visible in the heart of Leo and must be blocked from our field of vision.

The Geminids are undoubtedly the most consistent and reliable meteor showers year after year, and are also one of the most prolific, alongside the Quadrantids in January; they produce slower-moving but brighter meteors. In 2022, the Geminids will peak by night's end on December 13-14. However, we will have to contend with the waning gibbous Moon (full on the 7th, last quarter on the 16th); it will rise after 9 p.m., leaving a moonless viewing window as night falls on the 13th and 14th. The Geminid radiant is visible all night long and culminates around 2 a.m.

SEASONAL MILESTONES

The **autumn equinox** happens on September 22, 2022 at 9:03 p.m. EDT, and the **winter solstice** will occur on December 21 at 4:48 p.m. EST. Autumn will last exactly 89 days 20 hours 44 minutes.

We return to Winter Time early on Sunday morning, November 6. At 2:00 a.m. Eastern Daylight Time, clocks are set back one hour: It will then be 1:00 a.m. Eastern Standard Time.

PHASES OF THE MOON

*Eastern Standard Time, except * = Daylight Time*

New moon	First quarter
September 25 at 17:54*	October 2 at 20:14*
October 25 at 6:49*	November 1 at 2:37*
November 23 at 17:57	November 30 at 9:36
December 23 at 5:17	December 29 at 20:20
Full moon	**Last quarter**
October 9 at 16:55*	October 17 at 13:15*
November 8 at 6:02	November 16 at 8:27
December 7 at 23:08	December 16 at 3:56
January 6 at 18:08	January 14 at 21:10

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